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NEW DATA ON INFRARED RADIATION OF THE NIGHT SKY AND THE NORTHERN LIGHTS

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We briefly review infrared radiation of the night sky (1, 2, 3), which is closely connected with problems of atmospheric structure and, particularly, nitrogen dissociation at great heights. After the discovery of infrared radiation of the night sky by L. A. Kubetskiy (1) and Slipher (4) in 1939, Stebbins, Whitford, and Swings (5) in 1944-45 reported their discovery of very powerful infrared radiation with a wave length of about 10,440 A, with the aid of photocells and light filters. This wave length could be ascribed either to atomic nitrogen (10,398 A, 10,407 A) or to molecular nitrogen (10,439 A). Thus, the problem of nitrogen dissociation awaited more accurate determinations, very difficult for wave lengths of such weak (about 10^{-2} erg/cm^{2}sec sterad) radiation. In 1948, S. F. Rodionov and Ye. N. Pavlova (6), by measurements with photoelectronic multipliers and light filters, definitely found radiation with wave lengths close to 8,600 A and 10,440 A in the spectrum of night-sky luminescence, and also possible indications of 9,100 A. Later, V. I. Krasovskiy (7) connected an electronic-optical transformer with a photographic plate (2) to permit direct spectrography of night-sky luminescence over a broad spectrum, nearly up to 12,000 A. Preliminary measurements (7) in 1948 actually showed intense radiation around 8600 A and 10,400 A (actually diffuse bands rather than lines), and a quite intense continuous spectrum. Circumstances, however, prevented any reliable measurements of wave lengths. Then Krasovskiy (8) published more careful spectrographic measurements in the summer of 1949 of infrared night-sky luminescense.

The spectrograph used with electronic-optical transformer and photographic plate had linear dispersion from 1,200 to 2,400 A/mm and permitted measurements from 8,800 to 11,000 A. The resolving power was comparatively low, i.e., lines 0.05 mm apart could be distinguished.

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Microphotograms showed, in contrast to American data, no intense radiation around 10,400-10,440 A. Actually, the infrared spectrum of night-sky luminescence is much more complex. Besides the quite intense continuous spectrum, one observes lines corresponding to 8870 ± 2, 9391 ± 2, 9976 ± 2, $10,217 \pm 3$, $10,374 \pm 4$, and $10,827 \pm 3$ A, and apparently radiation at 9700 A; the weak line at 10,374 A almost combines with the line at 10,276 A, practically forming its sloping descent. Each of the above wave lengths were obtained as the average of 10-12 spectrograms. Krasovskiy emphasized that all these lines are strongly diffused and apparently do not represent separate lines, but are the superposition of a number of lines not resolved by the spectrograph. Thus, further studies are required to fix accurately the infrared spectrum of night-sky luminescence.

Krasovskiy processed the microphotograms by the usual methods of photographic photometry. Radiation around 8,900 A was most intense.

S. F. Rodionov and L. M. Fishkova (9) simultaneously reported their spectrophotometric study of infrared radiation of the northern lights. The authors' method was the same as that used in the photometric study of the night sky in 1948 (6), the measurements being made with photoelectronic multipliers and light filters which separated (with consideration for the selective sensitivity of the multiplier) the spectral regions, 9,000-10,800, 8,000-10,800, and 7,000-10,800 A. Thus it was possible to isolate three spectral intervals: 7,000-8,000, 8,000-9,000, and 9,000-10,800 A. (Vegard in 1939 and Meynel in 1948 reached 8,300 and 8,900 A respectively in the infrared).

Infrared radiation was compared with the intensity of the green line (5,577 A), isolated by an interference light filter, with the following results (for different types of radiation):

Intensity at 9,000-10,000 A: $(3.8 \text{ to } 9) \cdot 10^{-2}$ erg/cm^{2}sec sterad.

Intensity of the green line: $(9 \text{ to } 37) \cdot 10^{-4}$ erg/cm^{2}sec sterad.

Measurements of night-sky luminescence at the same latitude gave:

Intensity at 9,000-10,800 A: $(1.43 \text{ to } 1.94) \cdot 10^{-2}$ erg/cm^{2}sec sterad.

Intensity of the green line: $(1.55 \text{ to } 3.52) \cdot 10^{-4}$ erg/cm^{2}sec sterad.

The authors explain the slightly higher intensity of night-sky luminescense in comparison with that measured in 1948 on Mt El'brus ($1.25 \cdot 10^{-2}$ and $1.17 \cdot 10^{-4}$, respectively (6), by the fact that twilight conditions prevailed during the measurement period (March) in the north.

For the relative intensities of different parts of the spectrum ($I_{9,000\text{-}10,800A}$ was taken as 10), the following figures were obtained: $I_{8,000\text{-}9,000} = 1$ to 3.8, $I_{7,000\text{-}8,000} = 0.2$ to 0.85, $I_{5577} = 0.23$ to 0.61.

The arcs with a red hue visually were exceptional in that $I_{7,000\text{-}8,000}$ for them was 5.5 to 6.3.

For the night sky, $I_{8,000\text{-}9,000} = 1.3$ to 1.95, $I_{7,000\text{-}8,000} = 0.12$ to 0.66 and $I_{5577} = 0.12$ to 0.18.

Thus, green radiation of the northern lights is relatively more intense than in night-sky luminescence and varies more strongly for the two types of luminescence than does infrared radiation. The intensity of infrared radiation of the northern lights averages approximately 20 times that of the green line.

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Further detailed study of infrared radiation of the night sky and of the northern lights, using Krasovskiy's method, will undoubtedly clarify the structure of the higher atmospheric layers and the nature of night-sky luminescence.

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